Want more efficient muscles? Eat your spinach

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(PhysOrg.com) -- After taking a small dose of inorganic nitrate for three days, healthy people consume less oxygen while riding an exercise bike. A new study in the February issue of *Cell Metabolism* traces that improved performance to increased efficiency of the mitochondria that power our cells.

The researchers aren't recommending anyone begin taking inorganic nitrate supplements based on the new findings. Rather, they say that the results may offer one explanation for the well-known health benefits of fruits and vegetables, and leafy green vegetables in particular.

"We're talking about an amount of nitrate equivalent to what is found in two or three red beets or a plate of spinach," said Eddie Weitzberg of the Karolinska Institutet in Sweden. "We know that diets rich in fruits and

vegetables can help prevent cardiovascular disease and diabetes but the active nutrients haven't been clear. This shows inorganic nitrate as a candidate to explain those benefits."

In fact, up until recently nitrate wasn't thought to have any nutritional value at all. It has even been suggested that this component of vegetables might be toxic. But Weitzberg and his colleague Jon Lundberg earlier showed that dietary nitrate feeds into a pathway that produces nitric oxide with the help of friendly bacteria found in our mouths. Nitric oxide has been known for two decades as a physiologically important molecule. It opens up our blood vessels to lower blood pressure, for instance.

The new study offers yet another benefit of nitrate and the nitric oxides that stem from them. It appears that the increased mitochondrial efficiency is owed to lower levels of proteins that normally make the cellular powerhouses leaky. "Mitochondria normally aren't fully efficient," Weitzberg explained. "No machine is."

Questions do remain. The new results show that increased dietary nitrate can have a rather immediate effect. But it's not yet clear what might happen in people who consume higher levels of inorganic nitrate over longer periods of time. Weitzberg says it will be a natural next step to repeat the experiment in people with conditions linked to mitochondrial dysfunction, including diabetes and cardiovascular disease, to see if they too enjoy the benefits of nitrates.

"Among the more consistent findings from nutritional research are the beneficial effects of a high intake of fruit and vegetables in protection against major disorders such as cardiovascular disease and diabetes," the researchers concluded. "However, the underlying mechanism(s) responsible for these effects is still unclear, and trials with single nutrients have generally failed. It is tempting to speculate that boosting

of the nitrate-nitrite-NO pathway may be one mechanism by which vegetables exert their protective effects."

As an interesting aside, Weitzberg says that the benefits of dietary nitrates suggest that powerful mouthwashes may have a downside. "We need oral bacteria for the first step in nitrate reduction," he says. "You could block the effects of inorganic nitrate if you use a strong mouthwash or spit [instead of swallowing your saliva]. In our view, strong mouthwashes are not good if you want this system to work."

More information: Filip J Larsen, Tomas A Schiffer, Sara Borniquel, Kent Sahlin, Björn Ekblom,Jon O Lundberg, Eddie Weitzberg, Dietary inorganic nitrate improves mitochondrial efficiency in humans, *Cell Metabolism*, 2 February 2011

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